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ABSTRACT

Focusing on occupations in various manufacturing industries, this document is one in a series of forty-one reprints from the Occupational Outlook Handbook providing current information and employment projections for individual occupations and industries through 1985. The specific occupations covered in this document include occupations in aircraft, missile, and spacecraft manufacturing; occupations in the electronics industry; occupations in the motor vehicle and equipment manufacturing industry; and occupations in the office machine and computer manufacturing industry. The following information is presented for each occupation or occupational area: a code number referenced to the Dictionary of Occupational Titles; a description of the nature of the work; places of employment; training, other qualifications, and advancement; employment outlook; earnings and working conditions; and sources of additional information. In addition to the forty-one reprints covering individual occupations or occupational areas (CE 017 757-797), a companion document (CE 017 756) presents employment projections for the total labor market and discusses the relationship between job prospects and education. (BM)

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Aircraft, Missile, and Spacecraft; Office Machine and Computer; Electronics; and Motor Vehicle and Equipment Manufacturing Industries

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Occupational Outlook Handbook,
1978-79 Edition.

U.S. Department of Labor
Bureau of Labor Statistics
1978

Bulletin 1955-40

Containing the midpoints of the legs of right triangle *RST*, where
pt. (−5, 5). *S* is pt. (1, 1), and *T* is pt. (3, 4).

Containing the longer diagonal of a quadrilateral whose vertice
pts. (2, 2), (−2, −2), (1, −1), and (6, 4).

Show that the equations $y - 1 = \frac{3}{4}(x + 3)$ and $y - 4 = \frac{3}{4}(x$
are equivalent.

An equation of the line containing pts. (−2, 3) and (4, −1) ca
written in the form $y - 3 = -\frac{2}{3}(x + 2)$ or in the
$y + 1 = -\frac{2}{3}(x - 4)$, depending upon which point you take a
(x_1, y_1). Show that the two equations are equivalent.

Show that the equations are equivalent.

$$y - y_1 = \frac{y_2 - y_1}{x_2 - x_1}(x - x_1) \qquad y - y_2 = \frac{y_1 - y_2}{x_1 - x_2}(x - x_2)$$

State the equation of a line through pt. (p, q) and parallel to
containing pts. (a, b) and (c, d). $(a \neq c)$.

U.S. DEPARTMENT OF HEALTH,
EDUCATION & WELFARE
NATIONAL INSTITUTE OF
EDUCATION

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OCCUPATIONS IN AIRCRAFT, MISSILE, AND SPACECRAFT MANUFACTURING

Firms that manufacture and assemble aircraft, missiles, and spacecraft make up what is known as the "aerospace" industry. In 1976, more than 700,000 people worked in the industry—nearly 500,000 in the manufacture and assembly of complete aircraft, aircraft engines, propellers, and auxiliary parts and equipment; 85,000 in the manufacture of missiles and spacecraft; and 160,000 in companies that make electronic equipment and instruments for aircraft, missiles, and spacecraft. Thousands of workers in other industries produced parts, machinery, and equipment used in the manufacture of aerospace vehicles. Also, thousands of Federal workers were engaged in aerospace-related work, since the Government is a major purchaser of the industry's products. These workers were primarily employed in the National Aeronautics and Space Administration (NASA) and the Department of Defense.

Although aerospace jobs exist in almost every State, the largest concentration is in California. Other States with large numbers of aerospace jobs include New York, Washington, Connecticut, Texas, and Florida.

Nature of the Industry

All aircraft, missiles, and spacecraft have the same basic components—a frame, an engine, and a guidance and control system. Ballistic missiles and spacecraft travel into space at speeds many times faster than sound, while aircraft fly in the earth's atmosphere at much slower rates. Missiles are powered by either jet or rocket engines; spacecraft are rocket-powered only. Aircraft are powered by piston, jet, or rocket engines.

Aircraft vary from small personal or business planes that do not cost much more than an automobile to multi-million dollar jumbo transports and supersonic fighters. In dollar value most aircraft production is for military use although the value of planes made for commercial and private use has been increasing.

Missiles are for military use and generally carry destructive warheads. While some are capable of traveling only a few miles, such as those that support ground troops and defend against low-flying aircraft, others have intercontinental ranges of 7,000 miles or more. Some missiles are launched from land; others from aircraft, submarines, or ships.

Most of the Nation's spacecraft are built for NASA and the Department of Defense to explore outer space or to monitor conditions within the earth's atmosphere. On manned flights, a cabin capsule carries the astronauts. Some spacecraft probe the space environment and then fall back to earth, while others, such as those that monitor weather conditions, enter into earth orbit and become artificial satellites. Still others orbit or land on the moon or go to other planets. All spacecraft carry instruments that record and transmit scientific data to earth stations.

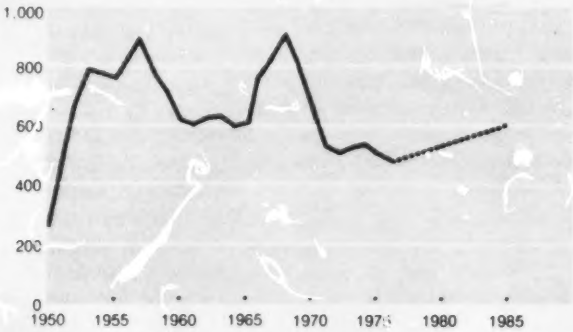
Major aircraft, missile, and spacecraft firms contract with government or private business to produce an aerospace vehicle. As a contractor, the firm is responsible for managing and coordinating the entire project. This involves design, production, assembly, and inspection of the vehicle.

Although aircraft, missile, and spacecraft manufacturers generally make many components of a craft and do final assembly work themselves, thousands of subcontractors are involved in the production of parts or supplies the original firm cannot produce, such as bearings, rocket fuels, or special lubricants. Other subcontractors produce subassemblies such as communication or guidance equipment or jet engines. Some of these firms depend on still other subcontractors to supply parts for their subassemblies.

In producing an aerospace vehicle, the contractor's engineering department first prepares design drawings and specifications, usually after long consultations with the purchaser. Then, the production department works on details for machines, materials, and operations needed to manufacture the vehicle. Often, special tools and machines must be designed and produced in order to make parts or to assemble the aerospace vehicle. This is especially true when a firm is developing an experimental or ultra-sophisticated vehicle requiring specially designed parts or assemblies.

Employment in aircraft and parts manufacturing increases sharply in times of accelerated defense spending

Wage and salary workers in aircraft and parts manufacturing, 1950-76 and projectd 1985



Source: Bureau of Labor Statistics

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Operator of braiding machine for aircraft ducts.

Once parts and components are developed, they are tested and inspected many times before being assembled. If the tests prove satisfactory, assembly of the entire craft may begin. Finally, the finished vehicle is checked out by a team of mechanics, or flight-tested if it is an aircraft, before it is delivered.

Occupations in the Industry

Because of the complex and changing nature of aerospace technology, firms need workers with many different types of skills. The types of workers required also will depend on the specific function of an aerospace plant. For example, a plant primarily engaged in research and development or in producing experimental prototypes requires many more scientists and engineers than a firm producing large quantities of parts for aircraft.

Major jobs in aerospace manufacturing are described under three main categories: Professional and technical; administrative, clerical, and related occupations; and plant occupations. Many of these jobs are in other industries as well and are discussed in greater detail elsewhere in the *Handbook*.

Professional and Technical Occupations. Research and development (R&D) are vital to the aerospace industry. The pace of discovery in aerospace technology is so rapid, in fact, that much equipment becomes obsolete while still in an experimental stage or soon after being put into production. Today, research is conducted in many areas such as developing vehicles with greater speeds, ranges, and reliability; engines with more power; and more advanced sources of rocket propulsion such as nuclear and electric energy. Metals and plastics also are continually being developed for wider capabilities, as are electronic guidance and communication system

Emphasis on R&D makes the aerospace industry an important source of jobs for technical personnel. In 1976, about one-fourth of all employees were engineers, scientists, and technicians, a considerably higher proportion than in most other manufacturing industries.

Engineers, scientists, and technicians work together in developing designs for aircraft, missiles, and spacecraft. Scientists often do research on how materials withstand certain conditions, such as intense heat or velocity, or create new materials that are needed. Engineers apply the information obtained by scientists to develop new designs. Before an engineering department approves a design for production, it conducts tests to determine which designs can best withstand expected operating conditions. A scale model is made from a preliminary drawing and is tested in wind, temperature, and shock tunnels and other testing areas that simulate actual flight conditions. Next, a full-sized experimental model, or prototype, is thoroughly tested in the air and on the ground. The design is modified many times during this process until the test results are satisfactory. Then, actual production may begin. Even after production has started, however, further changes often are made.

Due to the wide range of R&D projects, many types of engineers and scientists work in the aerospace industry. Aerospace, chemical, electrical, electronic, industrial, and mechanical engineers are among the larger groups of engineering specialists needed in this industry. Scientists in the industry include physicists, mathematicians, chemists, metallurgists, and astronomers. These engi-

neers and scientists work in a wide and varied range of applied fields such as materials and structures, energy and power systems, and space sciences.

Among the many types of workers assisting scientists and engineers are drafters and engineering and science technicians. Drafters use tools such as compasses and protractors to prepare detailed drawings of a design based on rough sketches and calculations made by engineers. The drawing details the exact measurement of every part, specifications for materials to be used, and the procedures to be followed in producing the object.

Engineering and science technicians assist scientists and engineers in R&D. They usually operate complex machinery and equipment to carry out tests under the supervision of a scientist or engineer.

Other workers who help scientists and engineers include *production planners* (D.O.T. 012.188), who plan the layout of machinery, movement of materials, and sequence of operations for efficient manufacturing processes; and *technical illustrators* (D.O.T. 017.281), who help prepare manuals and other technical literature describing the operation and maintenance of aerospace products.

Administrative, Clerical, and Related Occupations. Managerial and administrative jobs generally are comparable to similar jobs in other industries, except that in the aerospace industry these positions are often filled by people with technical backgrounds in engineering or science. These positions include executives responsible for the direction and supervision of research and production, and officials in departments such as sales, purchasing, accounting, and industrial relations. Many thousands of clerks, secretaries, computer personnel, and other office personnel work in aerospace firms.

Plant Occupations. About one-half of all workers in the aerospace industry have plant- or production-related jobs. Plant jobs can be classified in the following groups: Sheet-metal work; machining and tool fabrication; other metal processing; assembly and installation; inspecting and testing; flight checkout; and materials handling, maintenance, and custodial.

Sheet-Metal Occupations. Following blueprints and other engineering information, *sheet-metal workers* (D.O.T. 804.281) shape complicated parts from sheets of thin metal by hand or machine. When shaping parts by hand, these workers either pound them with mallets or bend, cut, or punch them with handtools. Machine methods use power hammers and presses, saws, tube benders, and drill presses. This work requires much precision since a part must fit perfectly.

Less skilled workers usually specialize in the use of a single machine to fabricate parts required in large numbers. Some of these workers are *punch press operators* (D.O.T. 615.782), *power hammer operators* (D.O.T. 617.782) and *power shear operators* (D.O.T. 615.782 and .885).

Machining and Tool Fabrication Occupations. Machining and tool fabrication workers use a wide variety of machines and handtools to make metal parts of machines or other products. Many of these workers are in engine and propeller plants, which are basically metal-working establishments; fewer are required in plants that assemble complete aerospace vehicles.

The most skilled machinists are the *all-round machinists* (D.O.T. 600.280 and .281) who plan the work and set up and operate several types of machine tools. They perform highly varied, nonrepetitive machining operations, frequently producing parts for experimental and prototype vehicles.

Machine tool operators (D.O.T. 609.885) produce metal parts in large volume. They generally operate a single type of machine tool such as a lathe, drill press, or milling machine. Skilled operators set up work on a machine and handle more difficult and varied jobs. Less skilled operators do more repetitive work.

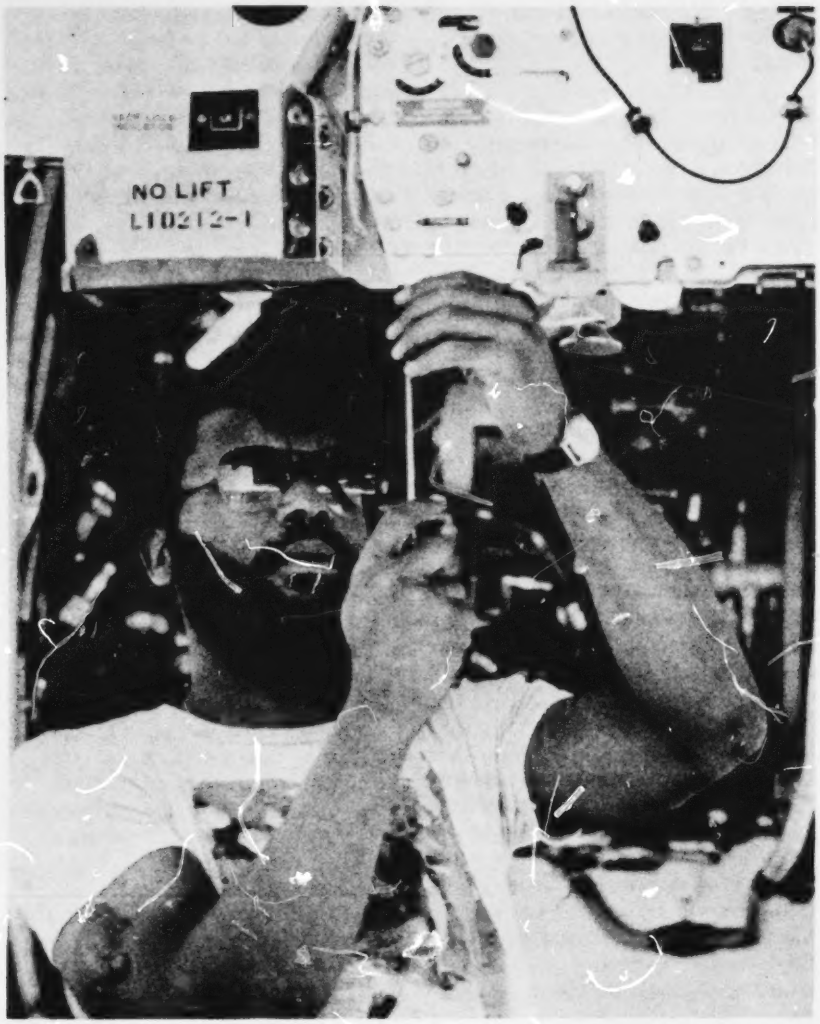
Other machining and tool fabrication workers produce parts needed for the manufacture of aerospace vehicles. On the basis of information received from an engineering department, *jig and fixture builders* (D.O.T. 693.280) build jigs—metal devices used as guides for tools. *Tool-and-die makers* (D.O.T. 601.280) make the cutting tools and fixtures used in machine tool operations, and the dies used in forging and punch press work.

Other Metal Processing Occupations. Some of the many other metalworking occupations are *tube benders* (D.O.T. 709.884), who form tubings used for oil, fuel, hydraulic, and electrical conduit lines; and *riveters* (D.O.T. 800.884) and *welders* (D.O.T. 810.782 and .884; 811.782 and .884; 812.884 and 813.380 and .885), who use mechanical and electrical devices to join fabricated parts. Metalworking jobs also are located in foundry plants where workers produce castings by pouring molten metal into molds.

Many workers chemically treat and heat-treat aircraft, missile, and spacecraft parts during their manufacture to clean, change, or protect their surfaces or structural condition. For example, *heat treaters* (D.O.T. 504.782) heat sheet-metal parts to keep the metal soft and malleable for metal-shaping work. *Painters* (D.O.T. 845.781) and *platers* (D.O.T. 500.380) either paint or plate surfaces.

Assembly and Installation Occupations. Practically all plants in the aerospace industry employ assembly and installation workers. Some assemble engines, electronic equipment, and auxiliary components, but most assemble major subassemblies or install major compon or spacecraft. In an aircraft, for example, this work involves joining wings and tails to the fuselage and installing the engine and auxiliary equipment such as the fuel system and flight controls. Assemblers rivet, drill, bolt, weld and solder parts together.

Many assemblers are skilled mechanics and installers who read blueprints and interpret other engineering specifications as they take apart, inspect, and install complex mechanical and electronic assemblies. Often, assembly work is not as repet-



Flight line mechanic tightens wing pylon during final assembly.

itive as in other industries. An assembler in an aerospace plant, for example, may spend a few months assembling a huge 747 aircraft and then work on the assembly of a small, two-seater plane. Some assemblers, such as *final assemblers* (D.O.T. 806.781) of complete aircraft and *missile or rocket assembly mechanics* (D.O.T. 625.281), do general assembly work, and often work on experimental, prototype, or special craft.

Other skilled assemblers who work in plants that produce relatively large numbers of aircraft and missiles rather than a few experimental types, however, often specialize in the assembly of one specific part of a space vehicle. Assemblers also specialize in systems such as electrical wiring, heating, and plumbing.

Inspecting and Testing Occupations. Because aircraft, missiles, and spacecraft are extremely complex and affect the life and safety of people, firms employ workers to conduct thousands of painstaking inspections and tests. Inspectors thoroughly test each component and part as it moves through the production and assembly process, as well as just before delivery. If, for example, a part must withstand a great deal of heat, it will be tested under very high temperatures. Inspections are made not only by employees of the manufacturers but also by commercial firms or agencies of the Federal Government that have contracted for the equipment.

Most inspectors specialize in a certain area of aerospace manufacturing. Using complex machinery, they check to assure that all parts and assemblies were made according to engineering specifications. Among the most skilled inspectors, especially in final assembly plants, are *outside production inspectors* (D.O.T. 806.381) who examine machined parts, subassemblies, and tools and dies ordered from other firms. They also serve as a link between their own engineering department and supplying companies. *Machined parts inspectors* (D.O.T. 609.381) examine machined parts and fabricated sheet-metal and *assembly inspectors* (D.O.T. 806.381) inspect complete major assemblies and installations such as fuselage, wing, and nose sections to insure their proper fit. They also check the functioning of hydraulic, plumbing, and other systems. Less skilled inspectors check subassemblies.

Flight Checkout Occupations. Checking out every part of an aircraft or spacecraft before its first flight requires a team of mechanics. The *crew chief*, the most skilled mechanic of the team, directs other workers in the entire checkout operation. *Engine mechanics* specialize in checking out the powerplant of a craft, including the engine, propellers, and oil and fuel systems; and *electronics checkout* workers do the final examination of the operation of radio, radar, automatic pilot, fire control, and electronic guidance systems. The checkout process may require making minor repairs and, in some cases, even returning the craft to the plant for extensive adjustments.

Materials Handling, Maintenance, and Custodial Occupations. Aerospace plants employ many materials handlers such as truckdrivers, shipping clerks, and toolroom attendants. Maintenance workers, such as electricians, maintenance mechanics, carpenters, and plumbers, keep equipment and buildings in good operating condition and make changes in the layout of the plant. Guards, firefighters, and janitors provide protective and custodial services.

Training, Other Qualifications, and Advancement

A college degree in engineering or in one of the sciences usually is the minimum requirement for an entry level position as an engineer or scientist in the aerospace industry. Technicians sometimes can advance to these positions without a college degree, but only after years of work experience and some college level training.

New entrants usually qualify for technician positions by attending a technical institute or junior college. Highly skilled plant workers who take courses in areas such as electronics may advance to technician positions.

Entry level plant occupations generally do not require a high school diploma although graduates of vocational courses in electronics or mechanics often are preferred. Inexperienced plant workers generally start out in semiskilled positions and learn skills on the job and in classroom courses. As they gain experience, they can move on to more highly skilled positions. For example, it usually takes 2 to 4 years of plant experience to become a skilled assembler.

Skilled inspectors often have several years of machine shop experience and must be able to install and use various kinds of testing equipment and instruments, read blueprints and other specifications, and use shop mathematics.

Mechanics who do final checkout of aircraft and spacecraft may qualify for their jobs by working in earlier stages of the production line, by receiving training in checkout work, or by working as "line maintenance" mechanics with commercial airlines.

Chief mechanics usually need 3 to 5 years of experience in the manufacture of aircraft, missiles, and spacecraft, including at least 1 year as a checkout mechanic. Specialized mechanics, working under the supervision of a chief mechanic, usually need at least 2 years' experience. Less experienced helpers or assistants learn on the job, with plant training courses.

Apprenticeship programs sometimes are available for craft occupations such as machinists, tool-and-die makers, sheet-metal workers, aircraft mechanics, and electricians. The programs vary in length from 3 to 5 years depending on the trade. During this time, the apprentice handles work of progressively increasing difficulty and also receives classroom instruction. Such instruction for a machinist apprentice, for example, includes courses in blueprint reading, mechanical drawing, shop mathematics, and physics.

Because complex and rapidly changing products require highly trained workers, aerospace plants sometimes support formal training to supplement day-to-day experience and to help workers advance more rapidly. Although most are short-term programs to meet immediate needs, some major producers conduct training classes or pay tuition and related costs for outside courses. Some classes are held during working hours; others are after working hours.

Employment Outlook

Employment in the aerospace industry is expected to rise above recent levels by the mid-1980's. The number of people working in this industry, however, probably will remain below the peak levels of the late 1960's.

Thousands of jobs will open each year because of the growth expected in the industry and to replace workers who retire, die, and transfer to jobs in other industries. Job opportunities are expected to increase for highly trained workers, such as scientists, engineers, and skilled plant personnel in all areas of the industry, especially with firms engaged in R&D and the manufacture of prototype and other technologically advanced aircraft. Less skilled and unskilled workers also will be needed to fill entry level plant positions.

Since many aerospace products are either military hardware or space vehicles, the industry's future depends, to a great extent, on the level of Federal expenditures. Changes in these expenditures usually have been accompanied by sharp fluctuations in aerospace employment. For example, aerospace employment declined sharply from the high levels of the late 1960's, partly because of decreased aircraft requirements for Vietnam and reduced expenditures for space exploration. The outlook for this industry is based on the assumption that defense spending will increase moderately from the 1976 level, but will be slightly below the peak levels of the late 1960's. R&D spending also is expected to be above current levels. If actual expenditures should differ substantially from these assumed levels, the outlook will be affected accordingly.

Civilian aircraft production also is an important determinant of aerospace employment. Overall employment in this area is expected to remain fairly stable through the mid-1980's. Nevertheless, thousands of new workers will be required in this sector of the industry to replace those who die, retire, or transfer to other fields.

Earnings and Working Conditions

Plant workers' earnings in the aerospace industry are higher than those in most other manufacturing industries. In 1976, for example, production workers in plants making aircraft and parts averaged $6.45 an hour; production workers in all manufacturing industries as a whole averaged about $5.19 an hour.

The following tabulation indicates an approximate range of hourly wages for selected occupations in 1976 obtained from the collective bargaining agreements of a number of major aerospace companies; these rates do not include incentive earnings. The ranges in various jobs are wide, partly because wages within an occupation vary according to workers' skills and experience, and partly because wages differ from plant to plant, depending upon type of plant, locality, and other factors.

Fringe benefits in the industry usually include 2 weeks of paid vacation after 1 or 2 years of service, and 3 weeks after 10 to 12 years. Employees generally get 8 to 12 paid holidays a year and 1 week of paid sick leave. Other major benefits include life insurance; medical, surgical, den-

Aircraft mechanics	$5.94–7.15
Assemblers	5.72–6.49
Electronics technicians	6.49–7.45
Heat treaters	5.84–6.77
Inspectors and testers	5.39–7.45
Jig and fixture builders	6.13–7.45
Machinists	5.67–7.45
Maintenance crafts	5.55–7.40
Riveters	5.61–6.27
Tool-and-die makers	6.37–7.45
Welders	5.84–7.17

tal, and hospital insurance; accident and sickness insurance; and retirement pensions.

Most employees work in modern factory buildings that are clean, well-lit, and well-ventilated. Some work outdoors. Operations such as sheet-metal processing, riveting, and welding may be noisy, and some assemblers may work in cramped quarters. Aerospace plants, however, are relatively safe.

Most plant workers in the aerospace field are union members. They are represented by several unions including the International Association of Machinists and Aerospace Workers; the International Union, United Automobile, Aerospace and Agricultural Implement Workers of America; and the International Union of Electrical, Radio and Machine Workers. Some craft workers, guards, and truckdrivers are members of unions that represent their specific occupational groups.

Sources of Additional Information

Additional information about careers in the aerospace field is available from:

National Aeronautics and Space Administration, Washington, D.C. 20546.

Electronics Industries Association, 2001 Eye St. NW., Washington, D.C. 20006.

For specific information about an occupation, or apprenticeships contact:

International Union, United Automobile, Aerospace, and Agricultural Implement Workers of America, 8000 East Jefferson Ave., Detroit, Mich. 48214.

International Union of Electrical, Radio and Machine Workers, AFL-CIO, 1126 16th St. NW., Washington, D.C. 20036.

OCCUPATIONS IN THE ELECTRONICS INDUSTRY

An astronaut, a doctor, a mechanic, and a business executive all have something in common; without electronic devices they would be unable to do much of their work. We would never have reached the moon without the thousands of people working in electronics research and production. Nor would doctors be able to diagnose and treat many diseases without modern electronic machines. Mechanics use electronic testing equipment to locate malfunctioning parts in numerous types of machines and engines. Business executives also owe a lot to electronics. Electronic computers, for example, provide them with better and more information, speed up payroll and building procedures, and reduce the cost of their operations.

Nature and Location of the Industry

The electronics industry dates back to the early 1900's when the first radios were produced. By 1930, the industry had expanded its research to include, for example, the development of crude television pictures in color. It wasn't until World War II, however, that electronics production really began to diversify. Efforts to develop a wide range of military products resulted in scientific advances such as electronic measuring and detecting equipment, air flight control equipment, and the digital computer. Today, the industry produces about 30,000 types of electronic goods.

The electronics industry is divided into four main market areas: government products, industrial products, consumer products, and components. Products sold to the government make up a large portion of electronic sales and include widely different items such as missile and space guidance systems, communications systems, and other electronic goods used in medicine, education, crime detection, and traffic control. Industrial purchases include computers, radio and television broadcasting equipment, telecommunications equipment, electronic office equipment, and production control equipment—all vital to daily business operations.

Consumer products are probably the most familiar types of electronic products. Every day thousands of people buy television sets, radios, stereos, and calculators. No electronic products could be developed, however, without their main ingredient—components. Some of the most well-known components are capacitors, switches, transistors, relays, television picture tubes, and amplifiers.

About 1.4 million persons were employed in the development, production, and sales of these products in 1976. Nearly three-quarters of them worked in plants that produce end products for government, industrial, and consumer use. The rest worked in plants that made electronic components.

Electronics manufacturing workers are located in all parts of the country, but the majority of the jobs in 1976 were in eight States: California, New York, Illinois, Massachusetts, Pennsylvania, Indiana, New Jersey, and Texas. Metropolitan areas with large numbers of electronics manufacturing workers include Los Angeles, Chicago, New York, Philadelphia, Newark, Boston, Baltimore, Indianapolis, and Dallas.

Occupations in the Industry

A wide variety of jobs exists in the electronics manufacturing industry. More than half of all workers are in plant jobs that include production, maintenance, transportation, and service occupations. The rest are scientists, engineers, and other technical workers, and administrative, clerical, and sales workers.

Professional and Technical Occupations. The electronics industry is dependent on research and development. As a result, a large proportion of its workers are in engineering, scientific, and other technical jobs. Engineers and scientists alone make up

Most electronics products are assembled by hand with small tools, soldering irons, and light welding machines.

about one out of every nine electronics workers.

Scientists in the electronics industry work in a number of areas. Many are involved in pure research—learning about why and how things react the way they do. Some apply this information to develop processes or products.

Physicists work with solid-state materials. They may develop uses for semiconductors and design integrated circuits for satellites. Chemists and metallurgists work mainly in materials preparation and testing, but also work in research and development of new processes. Mathematicians and statisticians use computer models to assist engineers and scientists on complex mathematical and statistical problems, especially in the design of military and space equipment and computers. Statisticians also are employed in quality control, production scheduling, and sales analysis and planning.

Engineers use their knowledge of mathematics and science to develop new products, processes, procedures, or systems to solve problems. Electrical and electronics engineers, the largest group of engineers in the industry, work on research and development, production, and quality control problems. Most of these engineers are highly specialized and may work in a specific area such as the design and implementation of solid-state circuitry in radar, computers, and calculators.

Mechanical engineers help develop new products, tools, and equipment by setting requirements for the strength of materials and designs. They may, for example, develop calculators and television antennas. Industrial engineers determine the most efficient methods to produce these products. They evaluate plant layout, machinery, and the number and type of personnel utilized in the plant, and make suggestions to lower cost and increase production.

Chemical, metallurgical, and ceramic engineers also work for electronics companies. Chemical engineers may design chemical plants and processes while metallurgical engineers determine the most efficient way to use metals in the company's products.

Industrial designers design the exteriors of electronic products. When designing a television set, for example, they must insure that all components fit, that the set is easy to use and repair, and that it is attractive enough to compete with others on the market.

Technicians—such as electronics technicians, drafters, engineering aides, laboratory technicians, and mathematical assistants—make up about 1 out of every 20 electronics manufacturing workers. Many electronics technicians help engineers design and build experimental models. They also set up and repair electronic equipment for customers. Other electronics technicians do complex inspection and assembly work. Drafters prepare detailed drawings from sketches or specifications furnished by engineers that show the exact dimensions of the entire object and its parts.

Engineering aides assist engineers by making calculations, sketches, and drawings, and testing electronic components and systems. Laboratory technicians help physicists, chemists, and engineers in laboratory analyses and experiments. Mathematical assistants follow procedures outlined by mathematicians to solve problems. They also operate test equip-

ment to develop computers and other electronic products.

Technical writers prepare training and technical manuals that describe the operation and maintenance of electronic equipment. They also prepare catalogs, product literature, and contract proposals. Technical illustrators draw pictures of electronic equipment for technical publications and sales literature.

Administrative, Clerical, and Related Occupations. About one out of four workers in electronics manufacturing has an administrative or other office job. Administrative workers include purchasing agents, sales executives, personnel specialists, advertising workers, and market researchers. Secretaries, typists, and business machine operators are among the thousands of other office workers employed by electronics firms. A growing proportion of these office workers operate computers.

Plant Occupations. About half of electronics manufacturing employees work in plant operations: assembly, capacitor and coil winding, inspecting, machining, fabricating, processing, and maintenance.

Assembly Occupations (D.O.T. 729.884, 720.884, 726.781 and .884). Assemblers, most of whom are semiskilled workers, make up the largest group of employees. Most end products are assembled by hand with small tools, soldering irons, and light welding machines. Assemblers use diagrams to guide their work. Some assembly is done by following instructions presented on color slides and tape recordings. Color slide projectors flash a picture of an assembly sequence on a screen, while the assembler listens to recorded directions.

Precision assemblers and electronics technicians install components and subassemblies in complex products such as missiles. They also help make experimental models. Most of these workers are employed in the manufacture of military and industrial electronic equipment.

Machines are used in some assembly work. For example, in putting together circuit boards, automatic machines often are used to position components on boards and to solder connections. Here the assemblers work as machine operators or loaders. Most components are put together by machines, since their assembly involves simple and repetitive operations. Even some types of miniaturized semiconductors and other components, made with parts small enough to pass through a needle's eye, are assembled by machines.

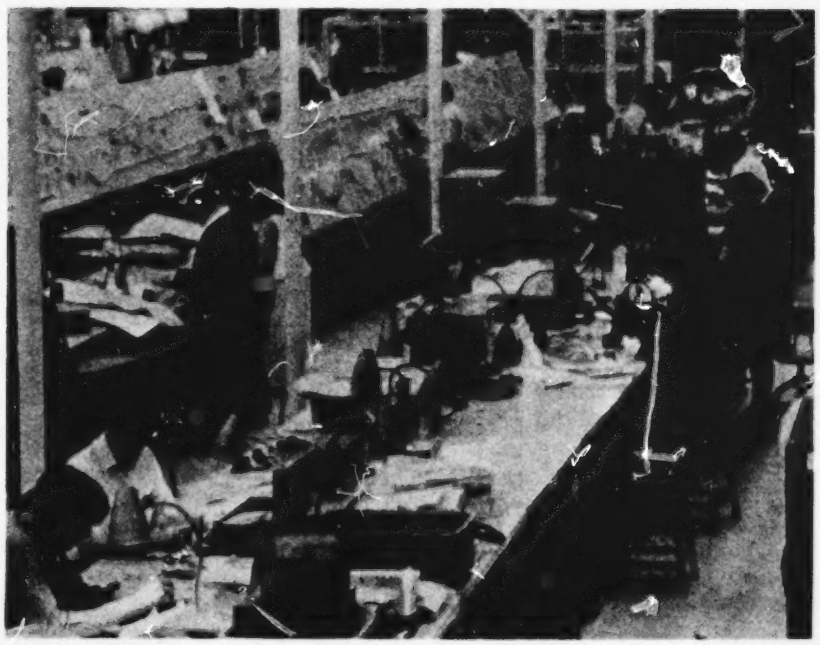
Hand assembly is needed for some items, such as receiving tubes and some types of resistors and diodes. Hand assemblers may perform only a single operation as components move down the production line, but some put together complete components. Tiny parts often are assembled under magnifying lenses or microscopes. Precision welding equipment may be used to weld connections in microminiature components and circuit assemblies.

Machining Occupations. Machining workers are needed in most electronics manufacturing plants, particularly for military, space, and industrial products. Machine-tool operators and machinists make precise metal parts. Toolmakers construct and repair jigs and fixtures that hold metal while it is being stamped, shaped, or drilled. Diemakers build metal forms (dies) used in stamping and forging metal.

Fabricating Occupations. Fabricating workers are employed in many electronics manufacturing plants, but most are in plants that make industrial products. Sheet-metal workers make frames, chassis, and cabinets. *Glass blowers* and *glass lathe operators* (D.O.T. 674.782) make tubes for experimentation and development work.

In electron tube manufacturing, special fabricating workers are employed. For example, *grid lathe operators* (D.O.T. 725.884) wind fine wire around two heavy parallel wires to make grids (devices in tubes that control the flow of electrons). Other fabricating workers include *coil winders* (D.O.T. 724.781 and .884), *crystal grinders* and *finishers* (D.O.T. 726.884), and *punch press operators* (D.O.T. 617.885).

Processing Occupations. Many electronics workers process or prepare parts for assembly. *Electroplaters* and *tinners* (D.O.T. 501.885) coat parts with metal; *anodizers* (D.O.T.



About half of electronics manufacturing employees work in plant occupations.

501.782) treat these parts in electrolytic and chemical baths to prevent corrosion. Other processing workers also coat electronic components with waxes, oils, plastics, or other materials. Some operate machines that encase microminiature components in plastic. *Silk screen printers* (D.O.T. 726.887) print patterns on circuit boards and on parts of electronic components. *Etching equipment operators* (D.O.T. 590.885) do chemical etching of copper on circuit boards.

Operators of infrared ovens and hydrogen furnaces (D.O.T. 590.885) remove moisture and foreign deposits from ceramic, metal, and glass parts. In tube manufacturing, *exhaust operators* (D.O.T. 725.884) and *sealers* (D.O.T. 692.885) operate gas flame machines that clear tubes of impurities, exhaust the gas, and seal the tubes.

Inspection Occupations. Inspection begins when raw materials enter the plant and continues through manufacturing. Some inspection jobs require electronics technicians who have years of experience. These jobs are commonly found in complex production work such as the manufacture of computers and spacecraft. Most inspectors, however, do not need extensive technical training.

Some inspectors check incoming parts and components supplied by other firms. They may have job titles that indicate the work they do, such as incoming materials inspector or plating inspector.

During manufacturing, components are either checked manually by workers using test meters or routed mechanically through automatic test equipment. Although many of these workers simply are called testers, others have job titles that reflect the type of components they inspect, such as transformer-tester or coil-tester. Some automatic equipment can check components, produce a punched tape of the results, and sort the components into batches for shipping. Workers who feed or monitor automatic equipment often are called test-set operators or testing-machine operators.

Electronic assembly inspectors (D.O.T. 722.281) examine assembled products to make certain that they conform to blueprints and specifications. They inspect wiring, electrical connections, and other critical items to make sure everything will work properly.

Maintenance Occupations. Many workers repair and maintain machinery and equipment. Skilled electricians are responsible for the proper operation of electrical equipment; machine and equipment repairers make mechanical repairs; maintenance machinists and welders build and repair equipment and fixtures. Air-conditioning and refrigeration mechanics work in air-conditioned plants that have special refrigerated and dust free rooms to protect sensitive parts. Painters, plumbers, pipefitters, carpenters, and sheet-metal workers also are employed in electronics plants.

Other Plant Occupations. Many workers move and handle materials. Forklift operators stack crates in warehouses, and load and unload trucks and boxcars. Truckdrivers move freight outside the plant. The industry also employs guards and janitors.

(Detailed discussions of professional, technical, mechanical, and other occupations, found not only in electronics manufacturing plants, but also in other industries, are presented elsewhere in the *Handbook* in sections covering the individual occupations.)

Training, Other Qualifications, and Advancement

Training requirements for jobs in electronics manufacturing plants range from a few hours of on-the-job training to years of specialized preparation. Beginning engineering jobs usually are filled by recent college graduates, but some positions call for advanced degrees. A small number of workers without college degrees, however, are upgraded to professional engineering classifications from occupations such as engineering assistant and electronics technician. Workers who become engineers in this way usually take advanced electronics courses in night school or in other training programs. To keep up with new developments and to qualify for promotion, professional and technical personnel obtain additional training, read technical publications, and attend lectures and technical demonstrations.

Almost all mathematicians, physicists, and other scientists employed in electronics manufacturing have college degrees; most have advanced degrees.

Technicians generally need specialized training to qualify for their jobs. Most electronics technicians attend either a public, private, or Armed Forces technical school. Some complete 1 or 2 years of college in a scientific or engineering field, and some receive training through a 3- or 4-year apprenticeship program. High school graduates who have had courses in mathematics and science are preferred for apprenticeship programs.

Some workers advance to electronics technician positions from jobs such as tester or laboratory assistant. A relatively small number of plantworkers become technicians. Opportunities for advancement are improved by taking courses either in company-operated classes, night school, junior college, or technical school, or by correspondence.

Electronics technicians need good color vision, manual dexterity, and good eye-hand coordination. Some technicians who test radio transmitting equipment must hold licenses from the Federal Communications Commission as first- or second-class commercial radio-telephone operators.

Drafters usually take courses in drafting at a trade or technical school; a few have completed a 3- or 4-year apprenticeship. Under an informal arrangement with their employers, some qualify for both on-the-job training and part-time schooling. Because many drafters in this industry must understand the basic principles of electronic circuits, they should study basic electronic theory.

Technical writers must have a flair for writing and usually are required to have some technical training. Employers prefer to hire those who have had some technical institute or col-

lege training in science or engineering. Many, however, have college degrees in English or journalism and receive their technical training on the job and by attending company-operated evening classes. Technical illustrators usually have attended art or design schools.

Many tool and diemakers, machinists, electricians, and other craft workers learn their trades by completing a 4- or 5-year apprenticeship; others are upgraded from helpers' jobs.

Formal training is not necessary for workers entering plant jobs, but a high school diploma or its equivalent is sometimes required. Job applicants may have to pass aptitude tests and demonstrate skill for particular types of work. A short period of on-the-job training generally is provided for inexperienced workers. Assemblers, testers, and inspectors need good vision, good color perception, manual dexterity, and patience.

Requirements for administrative and other office jobs are similar to those in other industries. Some beginning administrative jobs are open only to college graduates with degrees in business administration, law, accounting, or engineering. For clerical jobs, employers usually prefer high school graduates with training in stenography, typing, bookkeeping, and office machines.

Employment Outlook

Employment growth patterns will vary among the different sectors of the industry. While employment in some areas is expected to grow faster than the average for all industries through the mid-1930's, employment in other areas either will grow more slowly or possibly decline. In addition to the jobs resulting from employment growth, large numbers of openings will arise in all areas as experienced workers retire, die, or take jobs in other industries.

Production of industrial electronic products will increase as business executives buy more computers and other electronic equipment to automate paper work and production processes. Business spending for electronic communication and testing equipment also will grow. Although the demand for television receivers, video tape recorders, stereo systems, calculators, and two-way car radios will rise as population and personal incomes grow, the increasing level of imports may adversely affect production. As a result, employment in this industry may decline. Government purchases for defense will continue to account for a large proportion of electronics manufacturing output. An increasing share of government purchases, however, is likely to be for electronic equipment used in medicine, energy conservation, education, and pollution abatement.

Employment in the electronics industry may fluctuate from year to year, because of changes in economic activity and defense spending. As a result, job openings may be plentiful in some years, scarce in others.

The rates of employment growth also will vary among occupational groups and individual occupations. For example, employment of skilled maintenance workers and service technicians is expected to rise at a more rapid rate than total employment because of the need to repair the increasing amounts of complex machinery used to produce goods, or sold to consumers. On the other hand, employment of assemblers probably will rise at a slower rate because of the growing mechanization and automation of assembly-line operations.

Employment of engineers, scientists, and technicians is expected to increase faster than total employment, because of continued high expenditures for research and development and the manufacture of more complex products. Among professional and technical workers, the greatest demand will be for engineers, particularly those who have a background in certain specialized fields, such as quantum mechanics, solid-state circuitry, product design, and industrial engineering. Many opportunities also will be available for engineers in sales departments because the industry's products will require sales personnel with highly technical backgrounds. The demand for mathematicians and physicists will be particularly good because of expanding research in computer and laser technology.

Earnings and Working Conditions

As shown in the accompanying table, in 1976 electronics production workers who made products for government and industrial use had higher average hourly earnings than production workers in manufacturing as a whole. Those making other electronic products, however, made less than the average for all manufacturing industries.

Working conditions in electronics manufacturing compare favorably with those in other industries. Plants usually are well-lighted, clean, and quiet. Many plants are relatively new, and are located in suburban and semirural areas. The work in most occupations is not strenuous but assembly-line jobs may be monotonous.

The injury rate in electronics manufacturing has been far below the average in manufacturing as a whole, and injuries usually have been less severe.

Many workers in electronics manufacturing are union members. The principal unions are the International Union of Electrical, Radio and Machine Workers; International Brotherhood of Electrical Workers; International Association of Machinists and Aerospace Workers; and the United Electrical, Radio and Machine Workers of America (Ind.).

Type of product	*Production workers' average hourly earnings, 1976*
All manufacturing industries	$5.19
Major electronics manufacturing industries:	
Government and industrial electronics end products	6.45
Radio and television receiving sets, and phonographs	4.51
Electron tubes	5.22
Semiconductors and other components, except tubes	3.97

12

Sources of Additional Information

Information about careers in this field can be obtained from the public relations departments of electronics manufacturing companies, the unions previously listed, and from:

Electronic Industries Association, 2001 Eye St. NW., Washington, D.C. 20006.

MOTOR VEHICLE AND EQUIPMENT MANUFACTURING OCCUPATIONS

At the beginning of this century, motor vehicle manufacturing was a virtually unknown industry. Today, by a number of measures, the industry is one of the most important in the Nation.

A measure of an industry's role in the economy is the importance of the products it makes. The products of motor vehicle manufacturing cars, trucks, and buses are a vital part of our transportation system. Heavy trucks are used in industries such as mining to haul raw materials and heavy equipment, and by other industries such as trucking to carry a wide variety of goods from one part of the country to another. Small trucks carry bread, mail, building materials, and hundreds of other items for short distances. Buses are used for both local and transcontinental transportation, as well as for shipping some goods. Automobiles provide people with the ability to go anywhere in the country whenever they desire.

Another measure of an industry's economic importance is the number of people it employs. Motor vehicle manufacturing employs more workers than any other single manufacturing industry, almost 1 out of every 100 workers in the Nation's labor force works in motor vehicle manufacturing.

Still another indicator is the number of jobs an industry creates in other sectors of the economy. Motor vehicle manufacturing is important for two reasons. First, it is a major consumer of steel, rubber, plateglass and other basic materials needed to produce motor vehicles. As a result, numerous employment opportunities are created in the industries that produce these materials. Second, a number of industries employing large numbers of workers have been created because of motor vehicles. Some of these industries are motor vehicle repair shops, automobile dealerships, gas stations, highway construction, and truck and bus transportation facilities.

As in other large industries, the workers in motor vehicle manufacturing have widely different levels and types of education and training. Job requirements vary from a college degree for engineers and other professional and technical workers to a few hours of on-the-job training for some assemblers, materials handlers, and custodians.

Nature and Location of the Industry

The automobile industry is able to produce millions of vehicles because of mass production of standardized parts and assembly line manufacturing. Parts plants make thousands of interchangeable parts that are put together by workers at assembly plants to build complete vehicles. New cars are driven off the assembly line at the rate of about one a minute.

The industry has about 3,000 plants, ranging from small parts plants with only a few workers to huge assembly plants that employ several thousand. About 85 percent of the industry's employees work in plants with 500 workers or more.

Over two-thirds of the industry's employees work in the Great Lakes region, including Michigan, Ohio, Indiana, Illinois, Wisconsin, and western New York. Michigan alone has almost 40 percent of the total, with half of these workers in the Detroit metropolitan area. Other important industry centers in the Great Lakes area are Flint and Lansing, Michigan; Cleveland and Warren, Ohio; Indianapolis and Fort Wayne, Indiana; Buffalo, New York; and Chicago, Illinois.

Major automobile manufacturing centers are also found in other parts of the country, including Los Angeles, San Francisco, Kansas City, St. Louis, Atlanta, and Philadelphia.

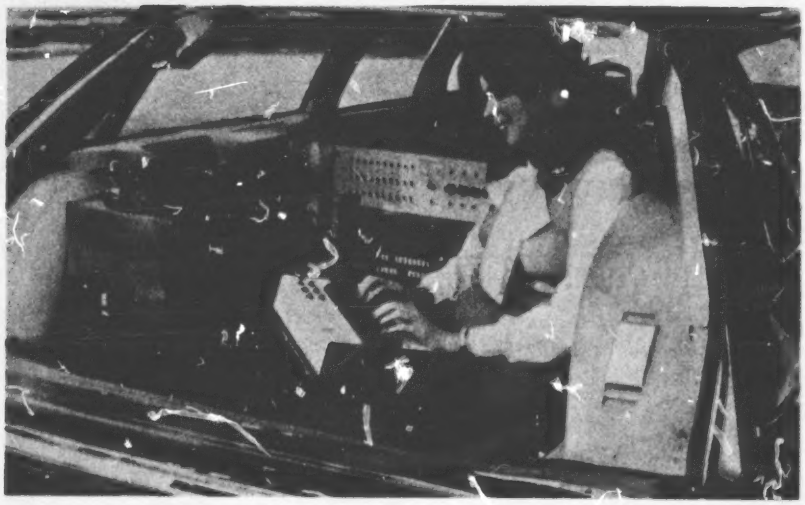
How Automobiles are Made

There are three stages in making an automobile: Designing, engineering, and testing; production of parts and subassemblies; and final assembly. Although the rest of this statement discusses only automobiles, the information also applies to trucks, buses, and other motor vehicles.

Designing, Engineering, and Testing. About 2 to 3 years of designing, engineering, and testing precede the actual production of a new car.

First, executives decide what type of car to produce—a sports car, compact, or luxury car—based on what their market research shows about consumers' desires. Once this decision has been made, they determine basic specifications for the car's size and cost. Design of the car's body and interior is assigned to stylists. From the sketches and drawings, skilled model makers make scale and full-size clay and fiberglass models of the car that are used to refine the styling, to evaluate safety features, and finally to make master dies for producing the car. Engineers, usually working with drafters who draw up blueprints and specifications, design the car's engine, transmission, suspension, and other parts. Their designs must meet safety and pollution control standards, as well as pass cost, fuel economy, and performance tests. They work with physicists, chemists, metallurgists, and other scientists to develop new parts, stronger and lighter metal alloys, new ways to use plastic and fiberglass, and thousands of other improvements in automobile design.

Each new design and improvement is thoroughly tested in the laboratory and on special test tracks that can duplicate almost every driving condition. Engines are run thousands of



On-the-road testing of fuel economy and tailpipe emissions.

miles to test their durability. Safety features are tested in the laboratory and in actual crashes. Components that fail must be redesigned before the car can be produced.

Production of Parts. Once the car's final design has been agreed upon and the decision to go ahead with production has been made, the thousands of parts that are needed to mass produce complete vehicles must be manufactured. Parts are made using a number of different methods and a variety of materials, including steel, copper, aluminum, glass, rubber, plastic, and fabric.

Even metal parts are made by a number of different methods. The metalworking process used to make each part is determined by a number of factors, including the size of the part to be made, the amount of stress to which the part will be subjected, and the degree of precision required. Bulky parts, such as engine blocks, are made using the casting process. Another process, called forging, is used for axles, crankshafts, and other parts that must withstand great amounts of stress. Body panels are made by a process called metal stamping in which huge presses stamp sheet metal into the shape of the desired part. Other parts such as alternators and carburetor parts are machined to exact dimensions. These metalworking processes are explained more fully under plant occupations.

A variety of manufacturing processes are used for the windows, trim, and interior. Plastic and glass parts are molded and cut, seat cushions are sewn, and many parts are painted.

Throughout production many inspections and tests are made to insure that the assembled car will meet quality and safety standards.

Final Assembly. After many months of designing, testing, and producing parts, the car is finally ready for assembly. Each worker on the assembly line has a specific task to perform as the conveyor carries the chassis along the assembly line. Axles are attached; the engine and transmission are mounted; body panels are welded together, painted, and joined to the chassis; and instrument panels and seats are installed. Near the end of the line, hubcaps, mirrors, and other finishing touches are added. Gasoline is pumped into the fuel tank, headlights and wheels are aligned, and the car is inspected and driven off the line. The whole final assembly process may take as little as 90 minutes.

Assembling hundreds of cars a day requires expert timing and coordination. Parts and subassemblies are delivered according to production schedules arranged months in advance in order that they may be fed without interruption to workers from storage areas along the assembly line. Workers at each assembly station receive instructions for the color and special equipment for each car that passes along the line. This allows cars of different colors and types to follow each other on the assembly line. A blue sedan, for example, may follow a red station wagon. Throughout the assembly process, inspections are made to assure that each car is being put together correctly.

Occupations in the Industry

The automobile industry employs workers in hundreds of occupations. Semiskilled plant workers, including assemblers and inspectors, make up about one-half of all employees. An additional one-quarter are supervisors, machinists, tool-and-die makers, mechanics,and other skilled craft workers. Clerical workers make up another one-tenth of the total. The rest are professionals, technicians, sales workers, managers, guards, and unskilled workers.

Some of the important occupations are described briefly below. Detailed discussions of many of the professional, technical, craft, and plant jobs may be found elsewhere in the *Handbook*.

Professional and Technical Occupations. The modern automobile is the product of the research, design, and development work of thousands of engineers, chemists, drafters, and other professional and technical workers.

Over 30,000 engineers worked in the automobile industry in 1976. Most of them were mechanical, electrical, or industrial engineers. Mechanical engineers design improvements for engines, transmissions, and other working parts. Electrical engineers design the car's electrical system, especially the ignition system and accessories. Industrial engineers concentrate on plant layout, work standards, scheduling, and other production problems. The industry also employs metallurgical, civil, chemical, and ceramic engineers.

The industry employed over 3,000 mathematicians, physicists, chemists, and other physical scientists in 1976.

Most of them work on research and development projects, such as finding ways to reduce fuel consumption and air pollution and studying the behavior of metals under certain conditions. Mathematicians and statisticians design quality control systems and work with research scientists and engineers. Some scientists supervise technical phases of production. Metallurgists, for example, supervise melting and heating operations in the casting and forging departments.

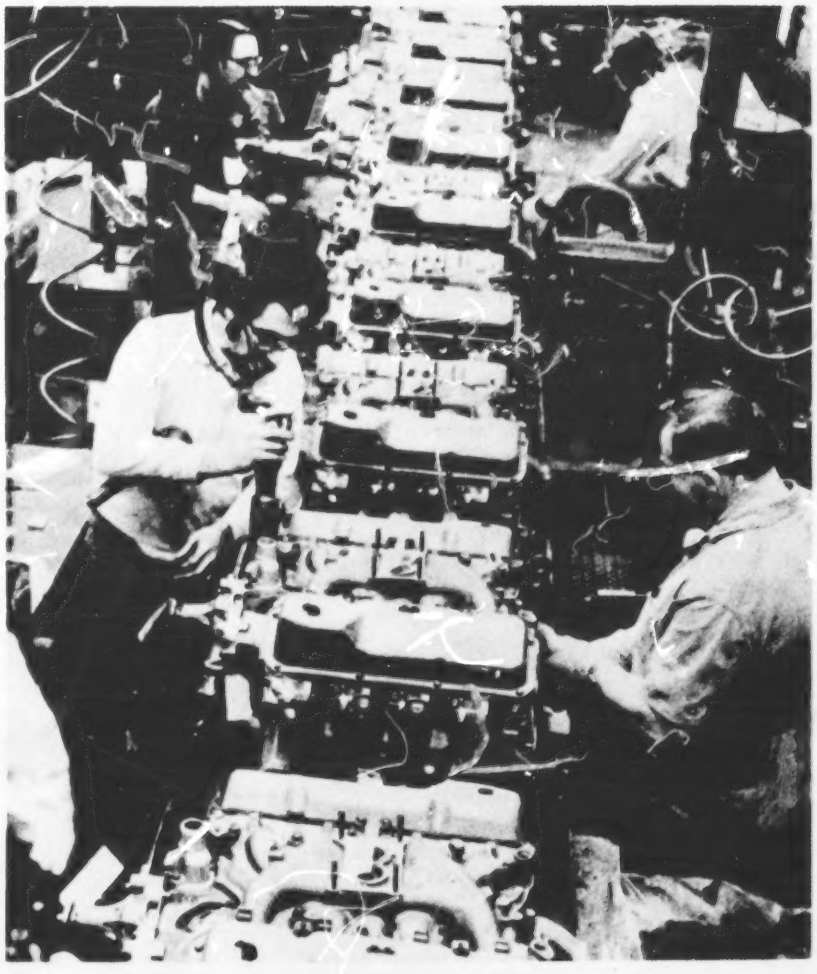
Drafters are the largest group of technical workers. They work closely with engineers and stylists to draft blueprints and specifications for each part of the car. Engineering aides, laboratory assistants, and thousands of other technicians also assist engineers and scientists.

Administrative, Clerical, and Related Occupations. Executives decide what kind of vehicles to produce, what prices to charge, where to build plants, and whether to manufacture or buy certain parts. They are assisted by lawyers, market analysts, economists, statisticians, industrial relations experts, and other professionals, who may also supervise plant or office staffs. Purchasing agents, personnel managers, and other administrative workers direct special phases of the company's business.

Secretaries, bookkeepers, shipping clerks, keypunch and business machine operators, typists, and other clerical employees work in the industry's plants and offices.

Plant Occupations. About three-fourths of the automobile industry's employees work in the plant. Most of these workers are engaged directly in the production process making parts or working on the assembly line. Other plantworkers such as maintenance machinists and stationary engineers help support the production process by servicing and repairing machinery and equipment.

Foundry Occupations. Engine blocks and many other parts are "cast" or molded from melted metal. Patternmakers, coremakers, and machine molders make sand molds that have a hollow space inside in the shape of the part they are making. Workers called melters and pourers melt the metal in electric furnaces, or cupolas, and pour it into the mold. After the metal cools and hardens into the shape of the part, shakeout workers remove the casting from the mold.



The largest group of workers in the automobile industry are assemblers.

Forging Occupations. Forging produces metal that is exceptionally strong; thus the forging process is used to make parts such as crankshafts and axles that must withstand heavy wear. Before metal can be shaped using this process, it must be heated in very hot furnaces called forges. After the metal is glowing hot, it is placed between two metal dies, which together form the shape of the desired part. Then, with tremendous force, these dies are brought together by hammers or presses that squeeze the metal into the desired shape. After the metal has been shaped, other workers remove rough edges and excess metal and perform other finishing operations such as heat treating and polishing.

Machining and other Metalworking Occupations. Most rough cast, forged, and some stamped parts must be machined to exact dimensions before they can be used. Engine cylinders, for example, must be bored out to precise dimensions that could not be achieved using the casting process alone. Machine tool operators, representing one of the industry's largest metalworking occupations, run machine tools that cut or grind away

excess metal from rough parts. Most operators use only one kind of machine tool and have job titles related to the type of machine tool they operate, such as lathe operator or milling machine operator.

Some machine tools are automatic and can be linked together to do a series of machining operations. A rough engine block, for example, can be moved through hundreds of automatic drilling, cutting, and grinding operations with little or no manual labor. Some of the inspection also is automatic. Operators of those machines are required only to monitor a control panel to spot interruptions and breakdowns. Other types of machine tools need more highly skilled operators who can change or adjust cutting edges, determine proper feed speeds for the metal to be machined, and check the accuracy of machined parts.

Assembly Occupations. The largest group of workers in the automobile industry are the *assemblers* (D.O.T. 806.887). They put together small parts to make subassemblies, and put subassemblies together to build a complete vehicle. Each assembler has a specific job to do as the vehicle passes a work station. For example, one worker mounts a tire and the next worker tightens the nuts with a power wrench. Most assembly jobs are repetitive and require limited skills. However, they do require good coordination, and may be strenuous.

Finishing Occupations. "Finishing" includes painting, polishing, upholstering, and other operations that protect the car's surface and add to the car's comfort and appearance. *Electroplaters* (D.O.T. 500.885) coat bumpers, grills, hubcaps, and trim with chrome. *Metal finishers* (D.O.T. 705.884) file and polish rough metal surfaces in preparation for painting. *Sprayers* (D.O.T. 741.887) apply primers and paint with power spray guns. *Polishers* (D.O.T. 705.884) polish finished surfaces by hand or with a power buffing wheel.

Several different kinds of workers are involved in making the car's upholstery. Working from a pattern, *cutters* (D.O.T. 781.884) cut fabric or leather with hand or electric shears. *Sewing machine operators* (D.O.T. 787.782) sew the pieces together into seat covers or headliners. *Cushion builders* (D.O.T. 780.884) fasten springs, padding, and foam rubber to the seats and other upholstered areas and install the covers.

Inspection Occupations. (D.O.T. 806.281, .283, .381, .382, .387, .684, and .687). Throughout the manufacture and assembly of a new car, inspectors check certain parts for defects. They inspect raw materials, examine parts during manufacturing, check the quality and uniformity of subassemblies, and test-drive the new car. Inspectors need various skills, depending on the part of the process they inspect. Some inspectors must be able to read blueprints and specifications to determine the required dimensions for the parts they check. They then use micrometers and other precision measuring instruments to insure that the parts meet specifications. Other inspectors use testing instruments such as dynamometers to be sure that engines are working properly.

Other Plant Occupations. Many other workers help keep the plant operating smoothly by delivering materials and parts, repairing equipment, and cleaning and guarding the plant.

Keeping the assembly line running smoothly requires an elaborate materials handling and delivery system. First, materials handlers load and unload raw materials and parts from trucks, ships, and railroad cars. Large and heavy materials—for example, heavy machinery or raw steel—are then moved about the plant by overhead crane operators, while other parts and materials are moved by power truck operators. Checkers, stock chasers, and stock clerks receive and distribute materials and keep records of shipments to make sure parts and tools are delivered to the assembly line at the right time.

A large staff of workers set up the plant's equipment and keep it in good condition. Skilled maintenance mechanics and electricians service and repair complex mechanical hydraulic, electrical, and electronic equipment. Millwrights move and install heavy machinery. Plumbers and pipefitters lay out, install, and repair piping, valves, pumps, and compressors. Carpenters, stationary engineers, and sheet-metal workers also work in automobile plants.

The industry also employs many protective service workers to keep plants secure and many custodial workers to keep them clean. Most of the protective service workers are guards, while janitors and porters make up a large portion of the custodial work force in the industry.

Training, Other Qualifications, and Advancement

Engineers and scientists must have at least a bachelor's degree with an appropriate major. Advanced degrees or specialized experience sometimes are required for research and development jobs. About a dozen colleges offer undergraduate or graduate courses in automotive engineering, and many companies have training programs in automotive specialties for engineers and scientists. Most companies also offer grants, loans, or tuition refund plans to their employees for advanced study. Engineers and scientists may become supervisors of research or production units, and sometimes enter administrative or executive positions.

Most automotive stylists are graduates of art institutes or have bachelor's degrees in industrial design. They should have a background in practical applications, such as model building, as well as in design theory and techniques.

Most engineering aides, laboratory assistants, drafters, and other technicians in the automobile industry are graduates of technical institutes or junior colleges. Others are trained on the job, at company schools, or at company expense at local technical schools or junior colleges. Technicians sometimes advance to engineering jobs through experience and study toward an engineering degree.

Although a college education is not always required, administrative jobs usually are filled by people with degrees in business administration, engineering, marketing, accounting, industrial relations and similar fields. Some companies offer ad-

vanced training in these specialties.

For semiskilled jobs, the industry seeks people who can do routine work at a steady pace. Most assembly jobs can be learned in a few hours, and the less skilled machine operating jobs can be learned in a few weeks. Plant workers should be in good health and have good coordination and ability to do mechanical work.

Tool-and-die makers, patternmakers, electricians, and some other craft workers in the automobile industry need at least 4 years of training. Although many persons learn their skills by working with experienced craft workers, apprenticeship training is the best way to learn a skilled trade. Automobile manufacturers, working with labor unions, offer apprenticeships in many crafts.

Applicants for apprenticeship usually must be high school, trade, or vocational school graduates, or have equivalent training. Training should include mathematics, science, mechanical drawing, and shop courses. Apprentices must pass physical examinations, mechanical aptitude tests, and other qualifying tests.

Apprenticeship includes both classroom and on-the-job instruction. Shop math, blueprint reading, shop theory, and special subjects such as electronics and hydraulics are studied in the classroom. In the shop, apprentices learn the techniques of their trade and how to use tools and machinery.

Supervisors usually are selected from workers already employed in the firm, especially if they have completed an apprenticeship and have considerable experience. Manufacturers usually have special training programs for newly promoted supervisors that provide instruction in the various aspects of their new job.

Employment Outlook

Employment in the automobile industry is not expected to increase significantly through 1985. Nevertheless, thousands of workers will be hired in this large industry each year to replace those who retire, die, or transfer to other industries. The total number hired will fluctuate from year to year because the industry is sensitive to changes in general business conditions, consumer preferences, availability of credit, and defense activity.

The production of motor vehicles is expected to increase during the next decade as population and income increase. Because of laborsaving technology, however, employment in the industry will not keep pace with production. Automobile companies will use more automated and computerized equipment for machining, assembling, and inspecting. A recent example is the versatile "industrial robot" that can be programmed to weld body panels, feed parts into machine tools, and do a variety of other tasks. Also, new or modernized plants will have the latest conveyor equipment for moving parts and materials.

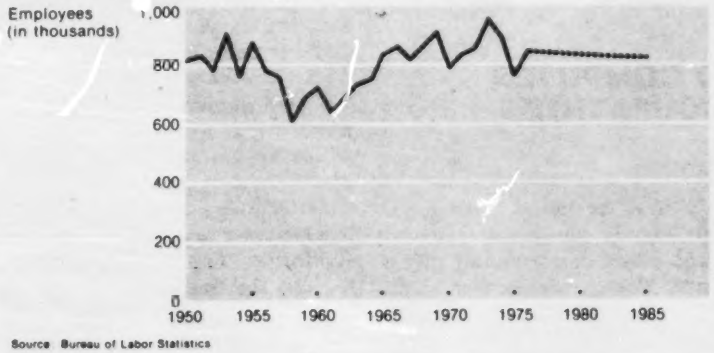
Some of the industry's increased efficiency, however, will be offset by other developments. For example, more workers will be needed to design, test, and build cars with improved safety, exhaust control, and fuel consumption features.

Changes in the kinds of vehicles built and how they are produced will affect the type as well as the number of workers employed in the automobile industry. More engineers, scientists, technicians, and other professionals will be employed to meet the industry's research and development needs, especially to design new engines, exhaust systems, and safety equipment. The use of computers will increase the need for systems analysts and programmers, but will limit employment growth in many clerical occupations.

The employment outlook for skilled workers in the industry varies by occupation. Little employment growth is expected for machinists and tool-and-die makers, for example, as more efficient metalworking processes are introduced. Some skilled occupations will grow, including electricians, millwrights, pipefitters, and machine repairers. Overall, the number of semiskilled workers will decline slightly.

Employment in motor vehicle manufacturing fluctuates with the economy, consumer preferences, credit availability, and defense activity

Wage and salary workers in motor vehicles and equipment manufacturing industry, 1950–76 and projected 1985



Source: Bureau of Labor Statistics

Earnings and Working Conditions

Production workers in the automobile industry are among the highest paid in manufacturing. In 1976 they averaged $7.10 an hour, compared to $5.19 an hour for production workers in all manufacturing industries.

Besides wages and salaries, automobile workers receive a wide range of fringe benefits. They are paid 1 1/2 times their normal wage for working more than 8 hours a day or 40 hours a week, or for working on Saturday. They receive premiums for

17

working late shifts, and double the normal wage for Sundays and holidays. Most workers get paid vacations (or payment instead of vacations) and 12 paid holidays a year. Most companies provide annual wage increases, plus automatic increases when the cost of living rises. Life, accident, and health insurance are provided, also.

A great majority of the industry's workers are covered by company-paid retirement plans. Retirement pay varies with the length of service. Many plans provide for retirement at age 55, or after 30 years of service regardless of age.

Most wage workers and some salaried employees receive supplemental unemployment benefit plans, paid for entirely by their employers. These plans provide pay during layoffs and also provide short-workweek benefits when workers are required to work less than a full week. During layoff, provisions are included for life, accident, and health insurance; survivor income benefits; relocation allowances; and separation payments for those laid off 12 continuous months or more.

Most production maintenance workers in assembly plants, and a majority in parts plants, belong to the International Union, United Automobile, Aerospace and Agricultural Implement Workers of America. In some parts plants, the International Union, Allied Industrial Workers of America is the bargaining agent. Other workers belong to the International Association of Machinists and Aerospace Workers; the Pattern Maker's League of North America; the International Molders' and Allied Workers' Union of North America; the Metal Polishers Buffers, Platers, and Helpers International Union; the International Union, United Plant Guard Workers of America (Ind.); the International Brotherhood of Electrical Workers; the international Union of Electrical, Radio, and Machine Workers; and the International Die Sinkers' Conference (Ind.).

Most automobile industry employees work in plants that are relatively clean and free of dust, smoke, and fumes. Some work areas, however, are hot, noisy, and filled with dust and fumes. These conditions have been greatly improved by the introduction of better ventilation and noise control systems.

Sources of Additional Information

Information on employment and training opportunities in the automobile industry can be obtained from local offices of the State employment service; employment offices of automobile firms; locals of the unions listed above; and from:

International Union, United Automobile, Aerospace and Agricultural Implement Workers of America, 8000 East Jefferson Ave., Detroit, Mich. 48214.

Motor Vehicle Manufacturers Association of the U.S., Inc., 320 New Center Building, Detroit Mich. 48202.

Information on careers in automotive engineering and a list of schools offering automotive engineering courses are available from:

Society of Automotive Engineers, 2 Pennsylvania Plaza, New York, N.Y. 10001.

OFFICE MACHINE AND COMPUTER MANUFACTURING OCCUPATIONS

During the last decade, employment in the office machine and computer industry grew much faster than employment in manufacturing as a whole. Growth was spearheaded by a rapid expansion in the production of computers. For many years, the industry's chief products were typewriters, adding machines, calculators, and other conventional office machines. Today, plants that make computers and related equipment account for about three-fourths of the industry's production.

Nature and Location of the Industry

In 1976, the office machine and computer manufacturing industry employed 290,000 workers in approximately 1,050 plants. About 6 out of every 10 of them worked in plants that produced computer equipment, the remainder in plants that produced conventional office machines and scales and other weighing devices.

Computer equipment manufacturing plants employed about 195,000 workers in 1976. These plants manufacture general purpose computers as well as those used for special applications, such as space exploration and missile guidance. They also manufacture related equipment such as machines that read magnetic numbers on bank checks. In addition to computers and related equipment, plants may furnish "software" (computer programs and operating systems that control the operation of the computer). Thousands of people whose employment is not included in this chapter are employed outside manufacturing plants by firms that specialize in software or that rent or lease computers and provide related services.

In 1976, about 95,000 people were employed in factories that produced conventional office machines and scales. Of this total, nearly half produced desk calculators, cash registers, coin and ticket counters, and adding, accounting, and voting machines; the rest produced typewriters, industrial and household scales and miscellaneous office machines, including items as diverse as postage meters and dictating machines.

Large plants account for most of the employment in office machine and computer manufacturing. About 65 percent of the industry's employees work in plants that have 1,000 or more employees; several computer plants have more than 5,000 employees.

Six of every 10 persons employed in computer manufacturing work in California, New York, and Minnesota, and the following States employ most of the remainder: Massachusetts, Pennsylvania, Colorado, Florida, Texas, Arizona and North Caro-

lina. In New York, the lower Hudson River Valley area has many important computer manufacturing centers: Poughkeepsie, East Fish Kill, and Kingston. Large manufacturing plants also are located in Utica, N.Y., and in the Boston, Mass., and Philadelphia, Pa. areas. The leading center in the Midwest is Minneapolis-St. Paul. The Los Angeles and San Diego industrial areas are the most important computer manufacturing centers in the West, followed by Phoenix, Ariz.; and San Jose, Calif.

Most of the conventional business machine manufacturing employment is located in eight States: Ohio, Kentucky, New York, Michigan, California, Illinois, New Jersey, and Connecticut. Some of the important manufacturing centers are: Dayton, Toledo, and Euclid, Ohio; the New York-Northeastern New Jersey industrial area; Hartford and Stamford, Conn.; Chicago, Ill.; Detroit, Mich.; and Lexington, Ky.

Occupations in the Industry

A variety of occupations, requiring a broad range of training and skills, are found in plants that make office machines and computers. More than half of the industry's workers are in white-collar jobs (engineering, scientific, technical, administrative, sales, and clerical); the others are in plant jobs (assembly, inspection, maintenance, transportation and service).

White-collar workers represent a significantly larger proportion of total employment in the computer industry than in most other manufacturing industries because of the highly complex nature of computer manufacturing.

Some of the key occupations in the office machine and computer industry are described briefly in the following section. (Detailed discussions of professional, technical, skilled, and other occupations found in this industry, as well as in many others, are presented elsewhere in the *Handbook*, in sections covering individual occupations.)

Engineering and Scientific Occupations. Nearly 1 out of every 10 workers in the office machine and computer industry is an engineer or scientist. Most of them work at computer plants.

The largest group of engineers work with electricity or electronics. Most are engaged in research and development, although many work in production. The industry also employs large numbers of mechanical and industrial engineers. Some mechanical engineers are engaged in product development and tool and equipment design. Others are concerned with the maintenance, layout, and operation of plant equipment. Industrial engineers determine the most effective means of using the basic factors of production—labor, machines, and materials.

Chemists make up the largest group of scientists in office machine and computer manufacturing. Their work is primarily in chemical processing of printed circuits used in computers. Mathematicians make up another large group of scientists. Their work on complex mathematical problems is important in designing computers. Physicists are employed in research and development to work on items such as miniaturized components and circuits. Statisticians work in fields such as quality control and production scheduling.

The industry also employs systems analysts and computer programmers, many of whom have scientific or engineering backgrounds. Systems analysts primarily devise new information processing techniques and improve existing techniques. Programmers design and test computer programs. Some analysts and programmers specialize in scientific and engineering problems, while others process accounting, inventory, sales, and other business data. In addition, systems analysts and programmers may assist sales personnel in determining data processing needs of customers.

Technical Occupations. More than 1 out of every 20 workers in the industry is a technician. Most specialize in electronics and assist engineers and scientists in research and development, testing and inspecting electronic components, and doing complex assembly work. Some electronics technicians specialize in repairing computers. Chemical control technicians prepare solutions used in the etching of circuit boards. Photographic technicians set up cameras and other equipment used in the tracing process to create copper etchings on circuit boards. Drafters prepare drawings from sketches or specifications furnished by engineers. Engineering aides assist engineers by making calculations, sketches, and drawings, and by conducting performance tests on components.

Administrative and Sales Occupations. About 1 out of every 13 workers is an administrator. Included are top executives who manage companies and determine policy decisions and middle managers who direct departments such as advertising and industrial relations. Other administrative employees in staff positions include accountants, lawyers, and market researchers.

Sales personnel hold about 1 out of every 25 jobs in the industry. Those who sell conventional office machines usually work on their own. Computer sales personnel, on the other hand, are assisted by a host of technical experts, such as engineers and systems analysts. Because computers are complex and expensive, computer sales representatives may have to spend several months to complete a sale.

Clerical Occupations. Nearly 1 out of every 6 workers in the industry is in a clerical job. Included in this group are secretaries, clerk typists, file clerks, bookkeepers, and business machine operators, as well as computer personnel such as keypunch and computer operators.

Plant Occupations. Nearly half of this industry's employees are plant (blue-collar) workers. Most plant workers are engaged directly in making computers and office machines. They include assemblers, inspectors or testers, machinists, machine tool operators, and their supervisors. Truckdrivers, material handlers, power truck operators, guards, and janitors move materials and perform custodial duties, and plumbers and pipefitters, electricians, carpenters, and other workers maintain produc-

tion machinery and building facilities.

Assembly Occupations. (D.O.T. 706.884, 726.781 and .884) Workers who assemble computers and office machines have many different skills, and make up the largest group of plant workers.

Assemblers may put together small parts to make components or components to make sub-assemblies or the finished product. Much of their work is done by hand. Some assemblers do a single operation as components move down the assembly line. The assembly of typewriters, for example, is divided into many simple operations. Each assembler does one job as the typwriter passes the work station. Some assembly jobs are difficult and require great skill, while others are relatively simple. Skilled electronics assemblers, for example, use diagrams as guides to wire complex memory and logic panels for computers.

Machines are used for many assembly operations. Automatic wire-wrapping machines, for example, wire panels and plug-in-boards. Operators feed these machines and remove and inspect finished items.

Electronic technicians usually do the most difficult hand assembly work. In research laboratories, they put together experimental equipment. In plants, they put together complex items that require a knowledge of electronics theory.

Assemblers commonly use screwdrivers, pliers, snippers, and soldering irons and they use special devices to position and hold parts during assembly. Some assemblers use precision equipment to weld connections in circuit assemblies.

Machining Occupations. Most office machine and computer manufacturing plants employ machining workers who operate power-driven machine tools to produce plastic and metal parts for computers, typewriters, accounting machines, calculators, and other products. Numerical control machine operators tend machines that have been programmed to perform machining operations automatically. Toolmakers construct and repair equipment used to make and assemble parts. Diemakers specialize in metal forms (dies) used in punch and power presses that shape metal parts.

Inspection and Testing Operations. These operations begin when raw materials enter the plant and continue throughout the assembly process. Finished parts and products are tested and inspected thoroughly.

Some inspectors examine individual parts; others inspect components during subassembly; still others inspect completed office machines and computers. Many inspecting jobs require highly skilled workers. On the other hand, relatively unskilled people can run some automatic test equipment. Workers who feed or monitor this equipment are called test-set operators or testing machine operators.

Job titles indicate the work many inspectors do. *Machined parts inspectors* (D.O.T. 609.381) use precision testing instruments to determine whether parts have been machined properly. *Type inspectors* (D.O.T. 706.687) use a magnifying glass to examine typewriter type for defects. *Electronic subassembly inspectors* (D.O.T. 726.384) use microscopes, meters, and various measuring devices to examine circuits and other electronic subassemblies. *Electronic assembly inspectors* (D.O.T. 722.281) use special instruments to test electronic systems such as computer memory units.

In plants that manufacture conventional office machines, final inspection is relatively simple. Inspectors operate the machines, look for defects, and refer malfunctioning machines to repairers. The final inspection or "debugging" of computers, on the other hand, is very complex. Electronic technicians inspect new computers under the supervision of electronic engineers. They use complex equipment to run tests and detailed drawings and instructions to find causes of malfunctions.

Maintenance Occupations. Many maintenance workers with different types of training take care of the industry's production machinery and equipment. Skilled electricians are responsible for the maintenance of electrical equipment. Machine and equipment repairers make mechanical repairs. Maintenance machinists and welders build and repair equipment. Air-conditioning and refrigeration mechanics are employed in plants that are air conditioned and have special refrigerated and dust-free rooms in order to maintain the equipment. Painters, plumbers, pipefitters, carpenters, and sheet-metal workers, and other building maintenance craft workers also are employed in this industry.

Other Plant Occupations. Many truckdrivers are employed to make deliveries to various parts of plants. Laborers load and unload trucks and boxcars and do general clean-up work. Some other plant occupations are boiler operator, stationary engineer, guard, and janitor.

Training, Other Qualifications, and Advancement

A bachelor's degree in engineering or one of the sciences is usually required for engineering and scientific jobs. For research and development work, applicants with advanced degrees generally are preferred. Some companies have training programs designed to give newly hired college graduates a broad picture of manufacturing operations before they are assigned to a particular department. Because of the highly technical nature of computers, many of the industry's executives have backgrounds in engineering or science.

Engineers and scientists, as well as persons with a degree in computer science, are employed as sales workers, programmers, and systems analysts. Most business and liberal arts graduates are employed in accounting, personnel, and other administrative activities.

Technicians qualify for their jobs in a number of ways. Some obtain training in either public, private, or Armed Forces technical schools. Others have one or more years of scientific or engineering training, but have not completed all of the requirements for a degree. Still other technicians are promoted from lower grade jobs in the plant and some well-qualified technicians may ad-

vance to engineering jobs after completing courses in mathematics, engineering, and related subjects.

People who complete commercial courses in high school or business school are preferred in clerical jobs such as secretary or office machine operator. For computer operators, most firms prefer applicants who have some college or technical training in data processing. With additional training, some computer operators and clerical workers advance to programmer jobs.

In selecting workers for plant jobs, firms generally prefer high school or vocational school graduates, who are then trained through on-the-job instruction and experience that varies from a few days to years. Some plants also conduct classroom training of short duration. Skilled craft workers, such as machinists and tool and die makers, may spend 3 to 4 years in learning their jobs and some firms have formal apprenticeship programs, which include both on-the-job training and classroom instruction related to the particular craft. Frequently, openings for skilled jobs are filled by workers already in the plant.

Workers who have little or no previous experience or training are hired for less skilled inspection, assembly, and machining jobs. Applicants may have to pass aptitude tests and demonstrate ability for particular types of work. Most assembly and inspection jobs require good eyesight and color perception, manual dexterity, and patience.

Experienced plant workers have opportunities to advance to jobs with higher pay. Assemblers, for example, can become semiskilled inspectors, and eventually skilled inspectors. Machine tool operators can move to skilled machinist jobs. Craft workers and skilled inspectors can become technicians, after completing courses in company-operated schools, junior colleges, or technical schools. Supervisory jobs are open to experienced plant workers who have leadership ability.

Employment Outlook

Employment in this industry is expected to increase faster than the average for all industries through the mid-1980's. This growth is projected to occur principally in plants that produce electronic computer equipment; little growth is forseen among manufacturers of conventional office equipment. In addition to the job openings that result from employment growth, many openings will arise as experienced workers retire, die, or transfer to jobs in other industries.

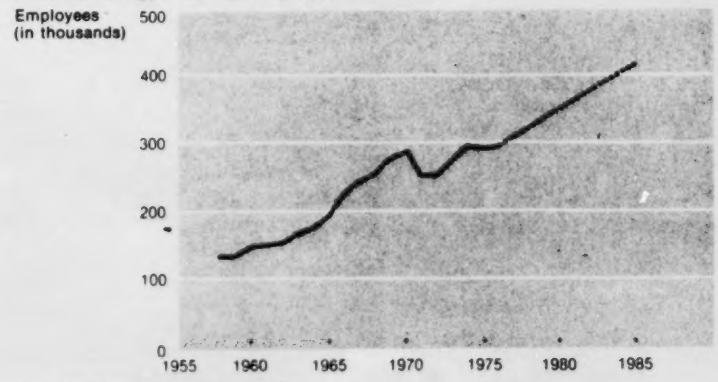
The demand for computers and related equipment is expected to increase rapidly as computers are used to solve an increasing array of problems in business, industry, and government. Using computers to control the flow of automobile traffic, to aid physicians make a medical diagnosis, and to help students learn more quickly are just a few of the new computer applications that are likely to come into widespread use over the next few years. In addition to growth generated by new applications, demand will rise as further price reductions bring a computer system within reach of more and more small organizations. Growth in the number of computers will be accompanied by a need for additional computer-related equipment—input and output, storage, and communication devices—as well as software designed specifically to meet the needs of certain types of organizations.

Although the demand for conventional office machines is expected to remain strong through the mid-1980's, employment in plants that produce this type of equipment will grow slowly. Most job openings will result from the need to replace experienced workers who retire, die, or transfer to other industries. The demand for office equipment should continue to rise as business and government organizations grow and the volume of paperwork increases. However, technological improvements in production methods are expected to increase output per worker. For example, increasing mechanization of operations formerly done by hand will tend to reduce labor requirements, particularly in plants where products are mass-produced, such as typewriters and calculators.

Some occupational groups in the office machine and computer manufacturing industry are expected to grow faster than others. For example, the number of professional and administrative workers, particularly engineers, scientists, and technicians, is expected to increase more rapidly than the number of plant workers. Demand for these workers will be spurred by continued high levels of research and development expenditures to improve machine capabilities, design more efficient software,

Very rapid employment growth is expected in plants that produce electronic computer equipment

Wage and salary workers in office and computing machine manufacturing, 1958-76 and projected 1985



Source: Bureau of Labor Statistics

21

and develop new applications for computers.

Semiskilled workers, such as assemblers and inspectors, will continue to account for most of the work force in production occupations, despite the growing use of automated and mechanized assembly line equipment.

Earnings and Working Conditions

In 1976, plant workers in the office machine and computer industry had average earnings of $5.29 an hour. Wages in computer manufacturing plants are slight higher than in the industry as a whole, averaging $5.46 an hour in 1976.

National wage data are not available for individual occupations in the office machine and computer industry. However, the following tabulation, based on data obtained from a small number of union contracts, provides an example of the range in hourly wage rates for selected occupations in 1976:

	Hourly rate ranges
Assemblers	$3.00–4.50
Machinists	4.38–5.82
Tool-and-die makers	5.50–6.50
Electricians	5.50–6.50

Some employees work night shifts and weekends because many plants operate around the clock. Employees working second or third shifts, or more than 8 hours a day or 40 hours a week generally receive extra pay.

Paid vacations and holidays are almost universal in this industry. Most employees receive 1 to 4 weeks of vacation, depending on length of service. They also receive insurance and pension benefits at least partially financed by the employer. Employee stock purchase plans are available in many firms.

In general, the work surroundings in office machine and computer plants are more favorable than those in most other types of factories. Work stations usually are well-lighted and clean, and free from dust, fumes, and loud noises. Many computer factories are relatively new and are located in suburban areas.

Some plant jobs are repetitious, but very few require great physical effort. Fewer and less severe injuries take place in office machine and computer manufacturing than the average for all manufacturing.

Many plant workers are covered by union contracts. The principal unions in this industry are the International Association of Machinists and Aerospace Workers; the International Union, United Automobile, Aerospace and Agricultural Implement Workers of America; the International Union of Electrical, Radio and Machine Workers; and the International Brotherhood of Electrical Workers.

Sources of Additional Information

For general information on jobs in the industry, write to:

American Federation of Information Processing Societies, Inc., 210 Summit Ave., Montvale, N.J. 07645.

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What to Look For in this Reprint

To make the *Occupational Outlook Handbook* easier to use, each occupation or industry follows the same outline. Separate sections describe basic elements, such as work on the job, education and training needed, and salaries or wages. Some sections will be more useful if you know how to interpret the information as explained below.

The TRAINING, OTHER QUALIFICATIONS, AND ADVANCEMENT section indicates the preferred way to enter each occupation and alternative ways to obtain training. Read this section carefully because early planning makes many fields easier to enter. Also, the level at which you enter and the speed with which you advance often depend on your training. If you are a student, you may want to consider taking those courses thought useful for the occupations which interest you.

Besides training, you may need a State license or certificate. The training section indicates which occupations generally require these. Check requirements in the State where you plan to work because State regulations vary.

Whether an occupation suits your personality is another important area to explore. For some, you may have to make responsible decisions in a highly competitive atmosphere. For others, you may do only routine tasks under close supervision. To work successfully in a particular job, you may have to do one or more of the following:

- motivate others
- direct and supervise others
- work with all types of people
- work with things—you need good coordination and manual dexterity
- work independently—you need initiative and self-discipline
- work as part of a team
- work with details, perhaps numbers or laboratory reports
- help people
- use creative talents and ideas
- work in a confined area
- do physically hard or dangerous work
- work outside in all types of weather

A counselor can help you find out more about your interests and abilities so you can judge whether a job's characteristics suit you.

The EMPLOYMENT OUTLOOK section tells whether or not the job market is likely to be favorable. Usually an occupation's expected growth is compared to the average projected growth rate for all occupations (20.1 percent between 1976 and 1985). The following phrases are used:

Much faster	50% or more
Faster	25.0 to 49.9%
About as fast	15.0 to 24.9%
Slower	4.0 to 14.9%
Little change	3.9 to -3.9%
Decline	-4.0% or more

Generally, job opportunities are favorable if employment is growing at least as fast as for the economy as a whole.

But, you would have to know the number of people competing with you to be sure of your prospects. Unfortunately, this supply information is lacking for most occupations.

There are exceptions, however, especially among professional occupations. Nearly everyone who earns a medical degree, for example, becomes a practicing physician. When the number of people pursuing relevant types of education and training and then entering the field can be compared with the demand, the outlook section indicates the supply/demand relationship as follows:

Excellent	Demand much greater than supply
Very good	Demand greater than supply
Good or favorable	Rough balance between demand and supply
May face competition	Likelihood of more supply than demand
Keen competition	Supply greater than demand

Competition or few job openings should not stop your pursuing a career that matches your aptitudes and interests. Even small or overcrowded occupations provide some jobs. So do those in which employment is growing very slowly or declining.

Growth in an occupation is not the only source of job openings because the number of openings from turnover can be substantial in large occupations. In fact, replacement needs are expected to create 70 percent of all openings between 1976 and 1985.

Finally, job prospects in your area may differ from those in the Nation as a whole. Your State employment service can furnish local information.

The EARNINGS section tells what workers were earning in 1976.

Which jobs pay the most is a hard question to answer because good information is available for only one type of earnings—wages and salaries—and not even this for all occupations. Although 9 out of 10 workers receive this form of income, many earn extra money by working overtime, night shifts, or irregular schedules. In some occupations, workers also receive tips or commissions based on sales or service. Some factory workers are paid a piece rate—an extra payment for each item they make.

The remaining 10 percent of all workers—the self-employed—includes people in many occupations—physicians, barbers, writers, and farmers, for example. Earnings for self-employed workers even in the same occupation differ widely because much depends on whether one is just starting out or has an established business.

Most wage and salary workers receive fringe benefits, such as paid vacations, holidays, and sick leave.

Workers also receive income in goods and services (payment in kind). Sales workers in department stores, for example, often receive discounts on merchandise.

Despite difficulties in determining exactly what people earn on the job, the Earnings section does compare occupational earnings by indicating whether a certain job pays more or less than the average for all nonsupervisors in private industry, excluding farming.

Each occupation has many pay levels. Beginners almost always earn less than workers who have been on the job for some time. Earnings also vary by geographic location but cities that offer the highest earnings often are those where living costs are most expensive.

What's an ad for the OOQ doing in a place like this?

The career information contained in the reprint you are reading was taken from the 1978–79 edition of the Occupational Outlook Handbook. But the Handbook is not the only source of useful career information published by the Bureau of Labor Statistics. The Handbook's companion, the Occupational Outlook Quarterly, is published four times during the school year to keep subscribers up to date on new occupational studies completed between editions of the Handbook. The Quarterly also gives practical information on training and educational opportunities, salary trends, and new and emerging jobs—just what people need to know to plan careers.

If you were a subscriber to recent issues of the Occupational Outlook Quarterly, you could have learned

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